

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims, including those in the First Preliminary Amendment, in the application:

Listing of Claims:

Claim 1 (currently amended): An electrochemical assay device with integrated amperometric flow monitoring devicee means, comprising characterised by:
a microfluidic system comprising at least one covered microchannel having an inlet and an outlet;
means for applying a pressure difference between the inlet and the outlet of said microfluidic system such as to generate a flow of solution within said covered microchannel; and
~~wherein the microfluidic system has~~ at least one electrode ~~for monitoring said~~
integrated in a wall portion of said microchannel, said electrode having precise size and location in said microchannel;
wherein said integrated electrode is adapted to monitor the solution flow of solution at said integrated electrode by measuring an electrochemical property of said solution amperometric or conductivity measurement, and wherein said integrated electrode is in addition adapted to electrochemically detect an analyte of interest during an assay.

Claim 2 (currently amended): The device of claim 1, wherein said solution comprises a reporter molecule for monitoring ~~said flow of solution by measuring said electrochemical property of said solution~~ the solution flow at said integrated electrode by amperometric measurement.

Claims 3-41 (canceled).

Claim 42 (new): The device of claim 1, wherein said pressure difference is induced by gravity, namely by a difference in solution height between the inlet and the outlet of said covered microchannel.

Claim 43 (new): The device of claim 42, wherein said microfluidic system is placed on or in a solid support which can be tilted in order to generate said difference in solution height between the inlet and the outlet of said covered microchannel.

Claim 44 (new): The device of claim 42, wherein said microfluidic system is adapted to generate a flow of solution within said covered microchannel without any pumping means.

Claim 45 (new): The device of claim 1, wherein said means for applying a pressure difference comprises an external actuator.

Claim 46 (new): The device of claim 45, wherein said external actuator comprises means for imposing a pressure on the fluid present at the inlet and/or within said microchannel, thereby generating a solution flow within said microfluidic system.

Claim 47 (new): The device of claim 45, wherein said external actuator comprises means for imposing an underpressure at the outlet of said microchannel, thereby enabling aspiration of said solution within said microchannel.

Claim 48 (new): The device of claim 2, wherein said reporter molecule is any one of ferrocene, ferrocene carboxylic acid, hexacyanoferrate and oxygen.

Claim 49 (new): The device of claim 1, wherein said microfluidic system comprises a material selected from polymer, glass, ceramic, another flow tied material and a combination thereof.

Claim 50 (new): The device of claim 1, wherein said microfluidic system comprises a multi-layer body.

Claim 51 (new): The device of claim 1, wherein said microfluidic system comprises a light-transparent material.

Claim 52 (new): The device of claim 1, wherein said microfluidic system is fabricated by a process selected from plasma etching, laser photoablation, embossing, injection molding, UV-liga, polymer casting, silicon etching and any combination thereof.

Claim 53 (new): The device of claim 1, wherein said microfluidic system comprises a network of microchannels.

Claim 54 (new): The device of claim 1, wherein said microchannel is covered by one of a lamination, a sealing plate and a plate fixed over said microchannel and maintained by external pressure.

Claim 55 (new): The device of claim 1, wherein said at least one electrode is composed of a conductive surface selected from a metal surface, carbon and a liquid/liquid interface.

Claim 56 (new): The device of claim 1, wherein said covered microchannel contains a biological compound.

Claim 57 (new): The device of claim 56, wherein said biological compound is selected from an enzyme, an antibody, an antigen, an oligonucleotide, DNA, a DNA strain or a cell.

Claim 58 (new): The device of claim 56, wherein said biological compound is immobilized in said covered microchannel.

Claim 59 (new): The device of claim 1, wherein the application of said pressure difference can be stopped.

Claim 60 (new): The device of claim 59, wherein the stopping of the application of said pressure difference is performed by mechanically blocking one of said inlet and said outlet of said microchannel.

Claim 61 (new): The device of claim 59, wherein the stopping of the application of said pressure difference is performed by adding a liquid immiscible with said solution to at least one of said inlet and said outlet.

Claim 62 (new): The device of claim 1, wherein said flow of solution is used in an affinity sorbent assay in order to perform incubation of a solution in said microchannel and/or washing of said microchannel.

Claim 63 (new): The device of claim 1, wherein said at least one integrated electrode is not in direct contact with said solution in said microchannel.

Claim 64 (new): The device of claim 1, wherein said at least one integrated electrode is adapted to detect an analyte by amperometric measurement.

Claim 65 (new): The device of claim 1, wherein said integrated electrode is adapted to simultaneously detect an analyte by electrochemistry and monitor the solution flow by amperometric measurement.

Claim 66 (new): The device of claim 1, wherein the solution flow within said microchannel is continuously monitored at the precise location of said integrated electrode by amperometric measurement during all the steps of an analytical assay preceding the detection of the analyte.

Claim 67 (new): A method of performing an analytical assay in a microfluidic system with amperometric flow monitoring, said method comprising the steps of:

- (a) providing a microfluidic system comprising at least one covered microchannel having an inlet and an outlet as well as at least one electrode integrated in a wall portion of said microchannel, said electrode having a precise size and location in said microchannel;

- (b) depositing a solution at the inlet of said covered microchannel;
- (c) applying a pressure difference between the inlet and outlet of said microchannel in order to generate a flow of said solution in said microchannel;
- (d) monitoring the solution flow at said integrated electrode by amperometric measurement; and
- (e) electrochemically detecting an analyte of interest by means of said integrated electrode.

Claim 68 (new): The method of claim 67, wherein steps b) to d) are repeated in order to perform a multi-step assay.

Claim 69 (new): The method of claim 67, wherein said pressure difference is generated by imposing an acceleration to the microfluidic system.

Claim 70 (new): The method of claim 69, wherein the flow of solution within said covered microchannel is generated without any pumping means.

Claim 71 (new): The method of claim 69, wherein said acceleration is induced by the displacement of said microfluidic system or of a solid support on or in which said microfluidic system is placed.

Claim 72 (new): The method of claim 71, wherein said displacement consists either in rotating or in vertically lifting said microfluidic system or its solid support, so as to generate a gravitation force or, respectively, a centrifugal force.

Claim 73 (new): The method of claim 67, comprising stopping the application of said pressure difference before the electrochemical detection of said analyte of interest.

Claim 74 (new): The method of claim 73, wherein the step of stopping the application of pressure difference comprises mechanically blocking one of said inlet and said outlet of said microchannel.

Claim 75 (new): The method of claim 73, wherein the step of stopping the application of pressure difference comprises adding a liquid immiscible with said solution to at least one of said inlet and said outlet.

Claim 76 (new): The method of claim 67, wherein an analyte detected in the assay is directly used to monitor said solution flow by measuring an electrochemical property of said solution comprising said analyte.

Claim 77 (new): The method of claim 67, wherein an analyte is detected by amperometry at said at least one electrode.

Claim 78 (new): The method of claim 77, wherein the monitoring of the solution flow and the detection of an analyte is performed simultaneously by amperometry at said integrated electrode.

Claim 79 (new): The method of claim 67, wherein the solution flow is continuously monitored during a multi-step assay, except during the electrochemical detection of said analyte of interest.

Claim 80 (new): The method of claim 67, wherein the solution flow is continuously monitored during a multi-step assay, except during the electrochemical detection of said analyte of interest.

Claim 81 (new): The method of claim 67, for performing chemical and/or biological analysis with electrochemical detection.

Claim 82 (new): The method of claim 81, for performing affinity assays such as immunological, oligonucleotide, hybridization or protein interaction assays.